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Entrepreneurship, Innovation, and Diversification During Times of Crisis: Challenges and Opportunities for Newfoundland

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Executive Summary

The current crash in global oil prices has shown the importance of diversifying economies away from dependence on oil extraction and towards higher value services both within the resource industry and in unrelated industries. Innovation both within the oil and gas industry (by entering the global value chain) or within unrelated industries (such as by applying ROV technology for building offshore wind farms) help detach the economy from dependence on a single economic engine and make it more resilient to economic shocks.

The oil and gas industry in Newfoundland has created a strong foundation for economic development; they contributed to a concentration of human and financial capital in the region that can serve as a platform for continued economic development. Entrepreneurs can potentially use this human and financial capital to diversify the economy away from depending on resource prices. However, the same forces that help build up these stocks of capital and skills also create barriers to diversification.

This report discusses the results of a study of entrepreneurial innovation in the offshore oil and gas regions of St. John's, Newfoundland and Aberdeen, Scotland. Drawing on a total of 68 interviews with entrepreneurs, investors, and economic development officials in both regions, this report discusses the barriers and opportunities facing these regions as they attempt to diversify their economies away from dependence on their local oil and gas production industry. Within St. John's economy, several major challenges were identified:

- A low rates of spinout creation by senior managers and engineers with oil and gas experience
- Increased unwillingness of global oil and gas operators to work with smaller startups
- Small local market for entrepreneurs to sell into
- Lack of skilled workers and difficulty of attracting new talent to a region
- Sparse investment community with few skilled angel investors

However, St. John's has several strengths that can help its entrepreneurial community, such as its strong community spirit and the strong commitment by its leading entrepreneurs to supporting the wider entrepreneurial ecosystem. Recent successes like CommonGround suggest a path forward to supporting entrepreneurship-led innovation and long-term diversification.

Growth and Diversification in Resource-Driven Economies

Resource driven economies are often said to be 'cursed' because the economic development created by extracting natural resources rarely outlast the resources themselves. Within more developed economies, Corden and Neary's (1982) 'Dutch Disease' shows how a fast growing resource sector can destabilise currencies and hurt unrelated manufacturing and service sectors. Indeed, many of these ideas were first pioneered by the Canadian political economist Harold Innis (1933) who studied the barriers Canada's economy faced in moving beyond exporting raw resources to the UK and the US and moving towards a more fully integrated industrial economy.

Innis made several key observations about the Canadian economy at the turn of the 20th century that largely still hold true almost 100 years later. First, he noted the history of Canada as an exporter of unprocessed natural resources of staples, ranging from beaver pelts to cod to timber to oil. Staples exporters are forced into a position as 'price takers', selling undifferentiated commodities whose prices are extremely vulnerable to price shocks. Innis noted that the Canadian economy seemed to be stuck in its role as a staples producer, unable to diversify the economy into industrial production or processing. This was because when commodity prices were good, the return on investments on resource extraction were far higher than in factories or other industries, meaning there was little reason to invest in new processing facilities. When prices declined, there was simply no capital available to invest in other sectors. As a result, some regions are very vulnerable to sudden drops in resource prices that are tied to global geopolitical developments, with few options during periods of protracted price decline.

But there are many examples of successful regions that started off as resource exactors but who have diversified their economy into related and unrelated sectors, helping to grow their economies while making them more resilient (though not immune) to downturns in global commodity prices. Cities like Houston, Texas, Aberdeen, Scotland, and Stavanger, Norway have grow beyond simply extracting oil and gas to more high-tech, value added sectors both within the oil and gas industry as well as beyond it in areas such as digital technology and health sciences.

Economic diversification is a key way of reducing this dependence on a single commodity. Regions' economic bases can diversify in two ways. First, *it can move up the value chain of the resource industry* by providing more value added services to the industry. When a resource is initially discovered and explored, a region might not have the skills or technology base to do anything besides the most basic of services, such as catering or transportation. But as time goes on, firms that once provided basic services can specialise and provide higher value services such as logistic, planning, and R&D. These services can be sold locally but also have global demand, allowing new firms to export their expertise worldwide. In Newfoundland, Provincial Aerospace is a good example of this route.

Second, firms can engage in related innovation whereby they *move into related fields and markets to what they are already doing*. For example, a firm that develops underwater ROVs for use in the offshore oil industry might adapt their technology to be more useful for inspecting offshore wind farms. While this may not require a great deal of innovation in their existing product line, it does require a good understanding of the needs of the new industry in

order to identify ways that their existing competencies can solve new problems and find customers in a field where they do not have an established track record.

Finally, firms can engage in *unrelated innovation in which they move into completely unrelated markets from what they have been previously doing*. Firms doing different work in a region might combine their expertise to develop totally new products. For example, an ROV company that is a world leader at vehicle automation might cooperate with a drone startup to develop new tools to quickly identify forest fires in remote areas. While difficult to predict, this type of innovation can help a region use its existing strengths to enter new markets. These processes are illustrated in Figure 1: firms can move up the value chain (a), move into similar markets through related innovation (b), or radically innovate and move into unrelated markets (c).

The specific nature of the oil and gas industry creates conditions to support all forms of innovation. The high wages of the industry attract highly skilled workers to a region who can go on to start and work at new, innovative ventures.

Entrepreneurs are key drivers of innovation and diversification (Neffke et al. 2014). By their very nature, entrepreneurs seek out new opportunities in the marketplace and look for ways to bring existing tools, technologies, and ideas to new markets and situations. While larger companies have more resources to invest in

R&D, entrepreneurs have the flexibility to creatively find new solutions for new challenges and are not burdened by the sunk costs and cultural myopia that often prevent larger firms from engaging with new markets and technologies. Over time, successful entrepreneurs can help diversify a region's economy into new directions. As firms grow, they hire and train more specialists in the field who gain experience. Some might spinout their own startups in these areas, other entrepreneurs may observe and imitate the successful firm, or other firms may relocate to the region to take advantage of the skilled workforce (Feldman 2001).

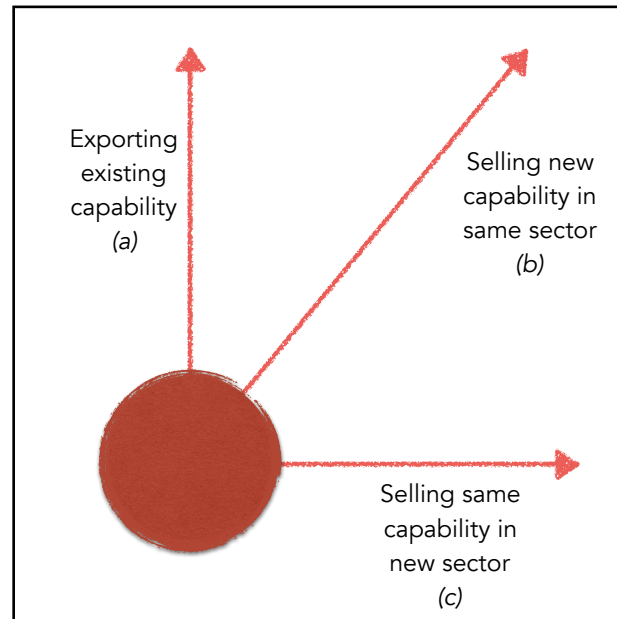


Figure 1: Types of Firm Innovation

Barriers to Entrepreneurial Diversification

While entrepreneurs have the potential to drive innovation and regional diversification, there are several barriers to their growth and ability to enter new markets. These barriers exist at the level of the firm, the region, and the marketplace.

First, new startup firms lack the resources and financing necessary to carry out intensive R&D-driven innovation. This is particularly true of products for enterprise markets like the offshore oil and gas industry, which require costly certification, testing, and integration before

they can be sold. New firms also lack an established track record that gives customers the confidence to try their new products when more established, competing products exist. Finding lead or test users can be very difficult and expensive proposition. Finally, entrepreneurs may lack the business and entrepreneurial skills necessary to build and grow innovative firms. This leads to costly mistakes that could have otherwise been avoided.

The larger economic, social, and cultural environment of a region may also hamper entrepreneurial development (Spigel 2013; Fritsch and Storey 2014). Regions may not have an entrepreneurial culture that encourages risk taking, innovation, and growth amongst entrepreneurs, investors, and workers. These places may have high start-up rates, but without a culture to encourage collaboration and support between entrepreneurs, few of these firms will grow and diversify into new markets. Regions without a history of successful entrepreneurship have a shortage of experienced mentors who can help guide new generations of entrepreneurs through the challenges of innovation and growth (Lafuente, Yancy, and Rialp 2007). A supportive culture helps to strengthen the ties between entrepreneurs, allowing them to connect and learn from each other as they go through the entrepreneurship process. Similarly, some regions don't have a critical mass of early-stage investors, venture capitalists, and other finance options can finance early entrepreneurial growth (Palacín-Sánchez and di Pietro 2015). Finally, regions may lack a sufficiently large pool of skilled workers who are willing and able to work in the fast-paced, risky, and competitive environments of a startup or scale up firm (Neff 2012). This may include everything from experienced programmers to welders to salespeople. Without this human capital, firms are limited in their ability to expand and build world leading products and services.

Entrepreneurs may also experience unique challenges of trying to enter or move up with value chain in particular industries. This may prevent them from being able to use a strong local industry as a base to build a much larger growth strategy. Capital intensive industries such as oil and gas are particularly difficult for entrepreneurs to penetrate (Acha and Cusmano 2005). Top operators have become increasingly closed off to working with smaller entrepreneurs, preferring to work with global oil service firms (Davis 2006). While the outsourcing of non-core activities such as building and maintaining infrastructure have created new opportunities for new entrepreneurs, entering this industry requires that an entrepreneur has a deep background in the industry with a great deal of technical legitimacy and social ties within the sector. As is the case in St. John's, most initial carried out as the production infrastructure is being developed is done by contract workers or outside international firms that locate in the region. If a region's culture, lack of resources, or other factors discourage experienced workers from an industry to leave their jobs to create new startups, there may be difficulty creating a sustainable pool of startups competing in this industry that will eventually help the region's economy diversify away from dependence on a single industry or resource.

Entrepreneurial Diversification in St. John's and Aberdeen, Scotland

As part of a larger project on entrepreneurial innovation and diversification, I carried out a study of technology entrepreneurs both within and outside of the offshore oil and gas industry in St. John's Newfoundland and Aberdeen, Scotland. Despite their different levels of development, the two cities are very similar. Both experienced profound poverty and underdevelopment prior to the discovery of large offshore oil deposits (Harris et al. 1986; House 1999). The construction, servicing and operation of offshore platforms provided a quick boost of economic activity and employment that created numerous opportunities for entrepreneurs.

The purpose of this study was to better understand the challenges and opportunities entrepreneurs face in these types of economies. Interviews were carried out between April 2014 and December 2015, with intensive research in St. John's carried out between September and November, 2014. This study period overlapped with the sharp decline in international oil and gas prices. As shown in Table 1, 68 interviews were carried out with entrepreneurs, investors, and local economic development officials.

Table 1: Location and Type of Interviews Carried Out

City	Entrepreneurs	Economic Development Officials	Investors	Total
St. John's	20	8	4	32
Aberdeen	27	8	1	36
Total	47	16	5	68

Entrepreneurship in the Offshore Oil and Gas Sector

The largest difference between the entrepreneurial activities of firms in St. John's and Aberdeen is the far lower rate of startups from Newfoundland working in the oil and gas sector. As shown in Table 2, while fully 60% of the interviewed firms in Aberdeen were in the oil and gas sector, this was only the case for 10% of St. John's firms. This was also the case when looking at who sold to the oil and gas sector, for example, a software developer who sells a well logging tool to oil and gas explorers (Table 3). Fully 77% of interviewed firms in Aberdeen sold to oil and gas sector while only 40% of St. John's startups did.

Table 2: Primary Industry of Interviewed Firms

City	Life Science	Consumer Technology	B2B Technology	Oil and Gas	Maritime Technology
St. John's	1 (5%)	5 (25%)	9 (45%)	2 (10%)	3 (15%)
Aberdeen	2 (7.4%)	1 (3.7%)	7 (26%)	16 (60%)	1 (3.7%)
Total	3 (6.3%)	6 (12.6%)	16 (34%)	18 (38%)	4 (8.5%)

Table 3: Selling into the Oil and Gas Sector

City	Sells to Oil and Gas Sector	Does Not Sell to Oil and Gas Sector
St. John's	8 (40%)	12 (60%)
Aberdeen	21 (77%)	6 (23%)

This has several causes. First, in St. John's there are few examples of experienced managers or engineers who have left a major operator or international service firm to found a new venture in this industry. Only 2 (10%) of the interviewed firms were founded by someone with experience in the industry, compared with 15 (55%) firms

in Aberdeen (Table 4). Many people I talked to suggested that this was a consequence of a risk-averse Newfoundland culture. In the words of an economic development official, "it would be highly unusual for someone to say: 'well, I'm going to quit my \$200,000 a year job to start a new venture.'" Other observers said that the high profits that could be made serving the local industry acted as a

disincentive to taking on the risks of expanding firms and trying to enter foreign markets. Another economic development official told me that "there's another category of firms that supply [the offshore platforms]they making a shit load of money in a very easy way. These folk I

suspect have no aspirations other than just to keep that up as long as they can."

This may also be a consequence of the relatively early stage of the industry in St. John's. In Aberdeen, many experienced workers leave a large employer like BP after 15 to 20 years because they feel the need to create something of their own and to reap the rewards of entrepreneurship. They are able to leverage their specialised expertise and large social networks within the industry that they have built up over decades. However, St. John's offshore industry is relatively new and is just reaching the point where locally-based workers have reached similar levels of experience. As a result, there is a much smaller pool of experienced offshore managers and engineers who can create successful spinouts.

Second, over the past few decades the oil and gas industry has become more difficult for smaller and younger firms to penetrate. The support infrastructure of the industry is now much more dominated by global Tier-2 supplies like Haliberton or Schlumberger with less room for new startups to gain a foothold. While local supply regulations require some portions of the construction and operation of the offshore platforms to be performed by local firms or workers, there is less room for local technology suppliers than ever before (Davis 2006; Fusco 2006). A local investor told me that "these sorts of opportunities are taken up by mostly industry players and not people like us." Another expert summed up the situation as "the oil and gas companies, they're not like a Google or Apple where they opening encourage entrepreneurship in their ranks."

These barriers present a challenge to fostering innovation in firms that move them up the oil and gas value chain from initially providing necessary services to local operators to

Table 4: Prior Experience in the Oil and Gas Sector

City	Prior Experience	No Prior Experience
St. John's	2 (10%)	19 (90%)
Aberdeen	15 (55%)	12 (45%)

becoming international technology providers. While there are some examples of this, such as Rutter and Provincial Aerospace, interviews suggest that this will be more the exception than the rule.

Barriers and Opportunities for Entrepreneurship and Innovation Outside the Oil and Gas Industry

Technology entrepreneurship in St. John’s outside the oil and gas sector runs the gamut from biotechnology to consumer electronics to enterprise software. While some of these firms had plans to adapt some of their existing technology and products to the oil and gas market, most saw this sector as outside their domain. Like with their counterparts in the oil and gas sector, these firms faced several challenges to starting and growing their firms. However, they also showed high levels of diversification not seen in Aberdeen.

Firms in St. John’s were much more likely to have purposefully entered a new sector or industry over the past three years. As shown in Table 5, half of the interviewed firms in St. John’s had invested time and money in either taking their existing product to a new market or developing a new product for a new market compared with 33% of firms in Aberdeen.

Table 5: New market entry

City	Entered New Market	No New Markets
St. John's	10 (50%)	10 (50%)
Aberdeen	9 (33%)	18 (66%)

Beyond this, a majority of interviewed firms in St. John’s were ‘born global’ in the sense that their initial customers and markets were not limited to Atlantic Canada but rather they sold their product globally from the start (Table 6). For most firms, this is crucial because the local market is not large enough to support any measurable growth. This suggests strong levels of innovation within St. John’s entrepreneurial community. While as the director of OceansAdvanced told me that “our innovation driver here...beings with O and ends with L,” there is substantial entrepreneurial innovation throughout the economy.

However, there are substantial barriers to growth and innovation for entrepreneurs

Table 6: Born Global

City	Born Global	Not Born Global
St. John's	11 (55%)	9 (45%)
Aberdeen	8 (29%)	19 (71%)

outside the oil and gas industry. The largest issues are a lack of skilled workers and the absence of a strong investment community in the region. This was an issue for many entrepreneurs regardless of their market sector. A life science entrepreneur told me that “unfortunately there’s not a lot of local talent we can lean on....there are probably literally 5 people I think we could hire locally. Otherwise we’d have to

bring on contractors from other areas.” Not unexpectedly, while Memorial and College of the Atlantic were praised for training skilled new workers, entrepreneurs said it was very difficult to attract talent from outside the region. Entrepreneurs outside the oil and gas industry found it difficult to match the high wages that have been offered by international operators. A digital entrepreneur said that “there are these two guerrilla companies that are taking all the smart

kids out of school. Who wouldn't want to make a six-figure salary as opposed to working in a startup and not making a six-figure salary?"

But the larger issue was the lack of local angel investors in the St. John's community. Angels provide early stage capital to innovative startups, giving them the financing they need to develop new products and enter new markets. Beyond the financial capital, good angel investors will also open doors to new opportunities and provide valuable audience as mentors and board members. Experts throughout the community felt that there were not enough experienced and successful entrepreneurs acting as business angels. Many of the region's high net-worth individuals come from more traditional business backgrounds such as retail or real estate development and do not have the experience necessary to evaluate technology startups. As a technology entrepreneur said: "investors here are your typical bricks and mortar investors who...definitely lack an understanding of high-tech." Entrepreneurs who had gotten local angel investment often found that the investors were naive, often expecting too high a stake in a firm and a high level of influence over the firm's strategic decisions. In the opinion of another tech entrepreneur, "my investors outside the province are more hands off...In Newfoundland, if they give you \$50,000 they want your first born."

Addressing the Challenges and Opportunities

Table 7 summarises the challenges identified in this research. Within the oil and gas sector, both structural conditions of the oil and gas industry and Newfoundland's culture act as barriers to entrepreneurship in the oil and gas sector. The largest issue is the lack of entrepreneurship amongst experienced oil and gas workers. Aberdeen's economy is powered by the continual flow of experienced managers and engineers out of major international firms and into entrepreneurship.

Efforts should be made to encourage entrepreneurship amongst these workers. While the current crisis makes for a poor environment for entrepreneurship in the sector, it also creates opportunities for entrepreneurship. As mentioned above, many senior managers do not want to give up the security of a stable job to start a new firm. Laid off workers do not face this barrier and may turn to entrepreneurship as a way to replace their lost income. It is important to provide entrepreneurship training to this group that goes beyond simple processes like business plan generation and bring in entrepreneurs who have been through similar processes (including locals as well as those from places like Aberdeen or Calgary) to show that such journeys are possible.

It is harder to address the structural issues in the oil and gas industry that make it increasingly difficult for entrepreneurs to enter local and global supply chains. While Newfoundland legislation has required varying levels of local content in the construction of the offshore rigs, this has often lead to foreign firms setting up satellite offices rather than providing sustainable opportunities for local startups. When fiscally possible, funds to help local entrepreneurs attend global oil and gas conferences will help them make the contacts necessary to internationalise their operations. Similarly, provincial officials might try to formalise attempts to identify and draw on the resources and social capital of Newfoundlanders living abroad and working in the oil and gas industry. Scotland's GlobalScots program connects

Scottish firms with Scots (or those with Scots heritage) living and working abroad who can provide valuable introductions and advice. This provides a good model for a low-cost, high-impact program that Newfoundland or St. John's can implement.

Table 7: Challenge facing startup technology firms in St. John's

	Challenges	Description
Oil and Gas Sector	Low number of spinouts from oil and gas industry	Few experienced workers leaving major producers to start new spinouts
	Internationalising locally-based products	Locally specific issues (e.g. sea ice) have limited market outside of Newfoundland
	Entering oil and gas supply chain	Major producers increasingly limiting ability of new firms to enter supply chain
Outside Oil and Gas Sector	Small local market	Limited local market to test out new products and interact with customers
	Few skilled workers	Lack of skilled tech workers and difficulty of attracting new talent to region
	Sparse investment community	Limited number of local angel investors with experience with technology startups

Outside the oil and gas sector, the priority should be placed on helping startups access Canadian and international markets. There is significant knowledge in the community about the challenges and opportunities of entering new markets, but new entrepreneurs might have difficulty accessing this. New groups like Common Ground and StartupNL bring together experienced and new entrepreneurs, allowing for the development of a supportive startup community. Rather than developing top-down entrepreneurship training programs, the public sector should seek to enable entrepreneurs to develop their own organisations and programs to address the issues they think are most important.

It may be impossible to develop a thriving angel investment community in Newfoundland. The St. John's region may be too small to produce the number of successful entrepreneurs and businesspeople who can act as early stage investors. It would be a mistake to invest too much effort in trying to attract investors from elsewhere or bring in local high net-worth individuals to angel investment group. Instead, policymakers can focus on two areas to compensate for the lack of angels. First, they can empower entrepreneurs to find alternatives to early stage angel investment. This might be helping digital entrepreneurs adopt lean, cloud-based Software as a Service business models (such as local firms like GreyMatter) that do not

require expensive capital investments prior to sales. Second, local leaders should seek to encourage other successful entrepreneurs to join investment groups, even if they themselves are not able to invest sizeable amounts. These entrepreneurs can become valuable board members or advisors to other firms.

Conclusion

While there have been a few visible successes of new firms using the local oil and gas industry as a platform to internationalise and enter the global energy supply chain, this remains the exception rather than the rule. The experience of Aberdeen shows that this kind of development is possible, but takes many decades to establish the institutional and cultural foundations for this. However, while this kind of development is key to local economic development, it does not reduce the region's exposure to economic shocks like the one that is currently happening. To make the region more resilient, we also need to see entrepreneurs entering other, unrelated industries. This can be by either using the technology developed to serve the oil and gas industry to serve other industries (such as Provincial Aerospace moving from sea ice detection to human trafficking monitoring) or in firms unrelated to the oil and gas industry benefiting from the concentration of talent and financial capital created by recent resource developments.

The research I conducted shows that there are significant barriers to the kind of entrepreneurship and innovation that is necessary to support a more resilient and knowledge-driven economy for Newfoundland. This includes both structural forces of the global oil and gas industry that makes it harder for new ventures to enter the supply chain to cultural barriers that discourage experienced oil and gas workers from starting their own startups and successful entrepreneurs from becoming new angel investors.

The St. John's community has many resources it can draw on to promote this kind of innovative entrepreneurship. The tight bonds within the local entrepreneurial community provides the opportunity to build a strong entrepreneurial environment based on peer learning and support. There is a strong commitment to helping the Newfoundland community in a way that transcends the need for maximising profits. These are key ingredients to building a strong entrepreneurial ecosystems that will only be helped by the successful exits of local startups like Bluedrop Learning (Spigel 2015).

These resources provide the potential to help Newfoundland escape the 'staples trap' that has entrapped it since its settlement by Europeans more than 400 years ago. This does not mean ignoring the resource economy but seeing it as a building block for more innovative entrepreneurship that can ultimately diversify the economy beyond providing local services for global operators. This development requires a keen understanding of the barriers facing entrepreneurs in order to formulate new solutions.

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